CLAIMS

What is claimed is:

1. A device for fluid cooled micro-scaled heat exchange from a heat source comprising:
   a. a micro-scaled region configured to permit flow of fluid therethrough; and
   b. a spreader region, wherein the spreader region comprises a first side and a second side, wherein the first side is positioned on and coupled to the heat source, and wherein the second side is coupled to the micro-scaled region.

2. The device in Claim 1, wherein the spreader region comprises a thickness dimension within the range of and including 0.3 millimeter to 1.0 millimeters.

3. The device in Claim 1, wherein the spreader region and the micro-scaled region are wider than the heat source, and wherein the micro-scaled region overhangs with respect to the heat source.

4. The device in Claim 3, wherein the dimension of the overhang of the micro-scaled region is in the range of and including 0.0 millimeters to 15.0 millimeters.

5. The device in Claim 1, wherein the micro-scaled region comprises microchannels, wherein the microchannels comprise walls.

6. The device in Claim 5, wherein at least one of the microchannel walls has a width dimension within the range of and including 10 microns to 100 microns.

7. The device in Claim 5, wherein at least one of the microchannel walls has a height

dimension within the range of and including 50 microns and 2.0 millimeters.

8. The device in Claim 5, wherein at least two of the microchannel walls are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

9. The device in Claim 1, wherein the micro-scaled region comprises a micro-porous structure.

10. The device in Claim 9, wherein the micro-porous structure comprises a porous material with a porosity within the range of and including 50 to 80 percent.

11. The device in Claim 9, wherein the micro-porous structure has an average pore size within the range of and including 10 microns to 200 microns.

12. The device in Claim 9, wherein the micro-porous structure comprises a height within the range of and including 0.25 millimeter to 2.0 millimeters.

13. The device in Claim 1, wherein the micro-scaled region comprises micro-pillars.

14. The device in Claim 13, wherein the micro-pillars comprise a plurality of pins, wherein at least one of the plurality of pins has a cross sectional area within the range of and including $(10\text{ micron})^2$ and $(100\text{ micron})^2$.

15. The device in Claim 14, wherein at least one of the plurality of pins has a height dimension within the range of and including 50 microns and 2.0 millimeters.

16. The device in Claim 14, wherein at least two of the plurality of pins are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

17. The device in Claim 1, wherein the micro-scaled region is comprised from the group of microchannels, a micro-porous structure, and micro-pillars.

18. The device in Claim 1, wherein the micro-scaled region comprises silicon.

19. The device in Claim 1, wherein the micro-scaled region comprises a material with thermal conductivity larger than 25 W/m-K.

20. The device in Claim 1, wherein the micro-scaled region comprises a high aspect ratio micro-machined material.

21. The device in Claim 1, wherein the micro-scaled region comprises semiconducting material.

22. The device in Claim 1, wherein the micro-scaled region comprises precision machined metals.

23. The device in Claim 1, wherein the micro-scaled region comprises precision machined alloys.

24. The device in Claim 1, wherein the spreader region comprises a material with a thermal conductivity value larger than 120 W/m-K.

25. The device in Claim 1, wherein the spreader region is interposed between the micro-scaled region and the heat source.

26. The device in Claim 1, wherein the spreader region comprises copper.

27. The device in Claim 1, wherein the spreader region comprises diamond.

28. The device in Claim 1, wherein the spreader region comprises silicon carbide.

29. The device in Claim 1, wherein the heat source is a microprocessor.

30. The device in Claim 1, further comprising a plurality of manifolding layers coupled to the spreader region.

31. The device in Claim 30, wherein the plurality of manifolding layers comprise interwoven manifolds.

32. The device in Claim 31, wherein the plurality of manifolding layers further comprise a plurality of individualized holes for channeling fluid into and out of the device.

33. The device in Claim 1, further comprising a plurality of manifolding layers coupled to the micro-scaled region.

34. The device in Claim 33, wherein the plurality of manifolding layers comprise interwoven manifolds.

35. The device in Claim 33, wherein the plurality of manifolding layers further comprise a plurality of individualized holes for channeling fluid into and out of the device.

36. The device in Claim 1, further comprising a plurality of fluid paths coupled to the micro-scaled region, wherein the plurality of fluid paths are configured to receive fluid and permit the flow of fluid therethrough.

37. The device in Claim 1, wherein the heat source, the spreader region, and the micro-scaled region are in a monolithic configuration.

38. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by an anodic bonding method.

39. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by a fusion bonding method.

40. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by a eutectic bonding method.

41. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by an adhesive bonding method.

42. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by a brazing method.

43. The device in Claim 1, wherein the micro-scaled region and the spreader region

are coupled by a welding method.

44. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by a soldering method.

45. The device in Claim 1, wherein the micro-scaled region and the spreader region are coupled by an epoxy method.

46. The device in Claim 1, wherein the fluid comprises water.

47. The device in Claim 1, wherein the fluid is comprised from the group of water, ethylene glycol, isopropyl alcohol, ethanol, methanol, and hydrogen peroxide.

48. A device for fluid cooled micro-scaled heat exchange comprising:

a. a heat source with a width;

b. a micro-scaled region configured to permit flow of fluid therethrough, wherein the micro-scaled region has a width, and a thickness; and

c. a spreader region with a width and a thickness, wherein the spreader region comprises a first side coupled to the heat source and a second side coupled to the micro-scaled region.

49. The device in Claim 48, wherein the heat source, the spreader region, and the micro-scaled region are in a monolithic configuration.

50. The device in Claim 48, wherein the spreader region and the micro-scaled region are wider than the heat source, and wherein the micro-scaled region overhangs with respect to the heat source.

51. The device in Claim 50, wherein the dimension of the overhang of the micro-scaled region is in the range of and including 0.0 millimeters to 15.0 millimeters.

52. The device in Claim 48, wherein the micro-scaled region comprises microchannels, wherein the microchannels comprise walls.

53. The device in Claim 52, wherein at least one of the microchannel walls has a width dimension within the range of and including 10 microns to 100 microns.

54. The device in Claim 52, wherein at least one of the microchannel walls has a height dimension within the range of and including 50 microns and 2.0 millimeters.

55. The device in Claim 52, wherein at least two of the microchannel walls are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

56. The device in Claim 48, wherein the micro-scaled region comprises a micro-porous structure.

57. The device in Claim 56, wherein the micro-porous structure comprises a porous material with a porosity within the range of and including 50 to 80 percent.

58. The device in Claim 56, wherein the micro-porous structure has an average pore size within the range of and including 10 microns to 200 microns.

59. The device in Claim 56, wherein the micro-porous structure comprises a height within the range of and including 0.25 millimeter to 2.0 millimeters.

60. The device in Claim 48, wherein the micro-scaled region comprises micro-pillars.

61. The device in Claim 60, wherein the micro-pillars comprise a plurality of pins, wherein at least one of the plurality of pins has a cross sectional area within the range of and including $(10 \text{ micron})^2$ and $(100 \text{ micron})^2$.

62. The device in Claim 61, wherein at least one of the plurality of pins has a height dimension within the range of and including 50 microns and 2.0 millimeters.

63. The device in Claim 61, wherein at least two of the plurality of pins are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

64. The device in Claim 48, wherein the micro-scaled region is comprised from the group of microchannels, a micro-porous structure, and micro-pillars.

65. The device in Claim 48, wherein the heat source is a microprocessor.

66. The device in Claim 48, wherein the micro-scaled region width is greater than the heat source width.

67. The device in Claim 48, wherein the micro-scaled region overhangs on each side of the heat source by a difference between the micro-scaled region width and the respective heat source width.

68. The device in Claim 67, wherein the difference between the micro-scaled region width and the respective heat source width is in the range of 0.0 millimeter to 15 millimeters.

69. The device in Claim 67, wherein the difference between the micro-scaled region width and the respective heat source width is in the range of 0.0 millimeter to 5.0 millimeters on each side of the heat source when the fluid is single phase.

70. The device in Claim 67, wherein the difference between the micro-scaled region width and the respective heat source width is in the range of 5.0 millimeter - 15 millimeters on each side of the heat source when the fluid is two phase.

71. The device in Claim 48, wherein the spreader region first side further comprises a higher thermal conductivity region coupled to the heat source.

72. The device in Claim 48, wherein the spreader region is interposed between the heat source and the micro-scaled region.

73. The device in Claim 48, wherein the spreader region comprises copper.

74. The device in Claim 48, wherein the spreader region comprises diamond.

75. The device in Claim 48, wherein the spreader region comprises silicon carbide.

76. A method for fabricating a fluid cooled micro-scaled heat exchange device comprising:

a. fabricating a micro-scaled region comprising silicon;

b. fabricating a spreader region comprising copper; and

c. coupling the micro-scaled region with the spreader region.

77. The device in Claim 76, wherein the spreader region and the micro-scaled region are wider than the heat source, and wherein the micro-scaled region overhangs with respect to the heat source.

78. The device in Claim 77, wherein the dimension of the overhang of the micro-scaled region is in the range of and including 0.0 millimeters to 15.0 millimeters.

79. The device in Claim 76, wherein the micro-scaled region comprises microchannels, wherein the microchannels comprise walls.

80. The device in Claim 79, wherein at least one of the microchannel walls has a width dimension within the range of and including 10 microns to 100 microns.

81. The device in Claim 79, wherein at least one of the microchannel walls has a height dimension within the range of and including 50 microns and 2.0 millimeters.

82. The device in Claim 79, wherein at least two of the microchannel walls are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

83. The device in Claim 76, wherein the micro-scaled region comprises a micro-porous structure.

84. The device in Claim 83, wherein the micro-porous structure comprises a porous material with a porosity within the range of and including 50 to 80 percent.

85. The device in Claim 83, wherein the micro-porous structure has an average pore size within the range of and including 10 microns to 200 microns.

86. The device in Claim 83, wherein the micro-porous structure comprises a height within the range of and including 0.25 millimeter to 2.0 millimeters.

87. The device in Claim 76, wherein the micro-scaled region comprises micro-pillars.

88. The device in Claim 87, wherein the micro-pillars comprise a plurality of pins, wherein at least one of the plurality of pins has a cross sectional area within the range of and including $(10 \text{ micron})^2$ and $(100 \text{ micron})^2$.

89. The device in Claim 88, wherein at least one of the plurality of pins has a height dimension within the range of and including 50 microns and 2.0 millimeters.

90. The device in Claim 88, wherein at least two of the plurality of pins are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

91. The device in Claim 76, wherein the micro-scaled region is comprised from the group of microchannels, a micro-porous structure, and micro-pillars.

92. The method of Claim 76, wherein the micro-scaled spreader region is fabricated

from precision machined metals.

93. The method of Claim 76, wherein the micro-scaled spreader region is fabricated from precision machined alloys.

94. A system for fluid cooled micro-scaled heat exchange comprising:

a. a heat source with a width;

b. means for spreading heat with a width, wherein the means for spreading heat is coupled to the heat source;

c. means for supplying fluids; and

d. means for micro-scaled fluid flow configured to receive fluid from the means for supplying fluid, wherein the means for micro-scaled fluid flow is coupled to the means for spreading heat.

95. The device in Claim 94, wherein the spreader region and the micro-scaled region are wider than the heat source, and wherein the micro-scaled region overhangs with respect to the heat source.

96. The device in Claim 95, wherein the dimension of the overhang of the micro-scaled region is in the range of and including 0.0 millimeters to 15.0 millimeters.

97. The device in Claim 94, wherein the micro-scaled region comprises microchannels, wherein the microchannels comprise walls.

98. The device in Claim 97, wherein at least one of the microchannel walls has a width dimension within the range of and including 10 microns to 100 microns.

99. The device in Claim 97, wherein at least one of the microchannel walls has a height dimension within the range of and including 50 microns and 2.0 millimeters.

100. The device in Claim 97, wherein at least two of the microchannel walls are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

101. The device in Claim 94, wherein the micro-scaled region comprises a micro-porous structure.

102. The device in Claim 101, wherein the micro-porous structure comprises a porous material with a porosity within the range of and including 50 to 80 percent.

103. The device in Claim 101, wherein the micro-porous structure has an average pore size within the range of and including 10 microns to 200 microns.

104. The device in Claim 101, wherein the micro-porous structure comprises a height within the range of and including 0.25 millimeter to 2.0 millimeters.

105. The device in Claim 94, wherein the micro-scaled region comprises micro-pillars.

106. The device in Claim 105, wherein the micro-pillars comprise a plurality of pins, wherein at least one of the plurality of pins has a cross sectional area within the range of and including $(10 \text{ micron})^2$ and $(100 \text{ micron})^2$.

107. The device in Claim 106, wherein at least one of the plurality of pins has a height

dimension within the range of and including 50 microns and 2.0 millimeters.

108. The device in Claim 106, wherein at least two of the plurality of pins are separated from each other by a spacing dimension within the range of and including 10 microns to 150 microns.

109. The device in Claim 94, wherein the micro-scaled region is comprised from the group of microchannels, a micro-porous structure, and micro-pillars.